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    <TD WIDTH="15%" NOWRAP VALIGN="top">(72)Inventor : </TD><TD WIDTH="45%"
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<TR><TD>(54)<B> FIELD INTERPOLATION METHOD
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(57)Abstract:
PROBLEM TO BE SOLVED: To suppress mis-detection and detection omission without increasing an arithmetic quantity.
SOLUTION: Sets (D, D') of object values are decided in the same field as that for interpolation pixels on the basis of values of pixels (A, B, C) and (C', B', A') closest to the interpolation pixel on two lines vertically adjacent to the interpolation pixel (S1). A maximum value G, a minimum value L of the sets (D, D') of the object values and a mean value Z of pixel values X, Y at the same position as that of the interpolation pixel in two adjacent fields are calculated (S2). A variable (s) that changes within a range of 0≤s≤(an absolute value of pixel value fluctuation width) is calculated so as to be smaller as each of motion coefficients k is greater on the basis of the history of the motion coefficients k (S2, S4). A median median (G+s, L-s, Z) is calculated (S5) and this median is adopted as a value of an interpolation pixel (S6).

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<HR>CLAIMS
<HR>[Claim(s)]

[Claim 1]

It is the field interpolation approach of changing an interlace image into a non-interlace image by interpolating Rhine in each field.
The process which determines the value of the interpolation pixel which is a pixel on Rhine which should be interpolated is (a). In the same field as said interpolation pixel
The 1st candidate value which is the candidate of the value of said interpolation pixel based on the value of the pixel of M (>=1) individual nearest to said interpolation pixel on Rhine which adjoins above said interpolation pixel,
The 2nd candidate value which is the candidate of the value of said interpolation pixel based on the value of M pixels nearest to said interpolation pixel on Rhine which adjoins under said interpolation pixel,
The process to compute and (b) The process which computes the maximum of said 1st candidate value and said 2nd candidate value,
(c) The process which computes the minimum value of said 1st candidate value and said 2nd candidate value,
(d) The process which computes the average of the pixel value in the location corresponding to said interpolation pixel in 2 fields which adjoin before and behind said same field,
(e) Depending on the motion multiplier in the location corresponding to said interpolation pixel in the field of N (>=1) individual chosen by within the limits before said same field, so that it may become so small that each of these motion multipliers is large
The process which computes the variable which changes in the range from zero to the absolute value of the pixel value range of fluctuation, and (f) The field interpolation approach equipped with the process which computes the mean value of the value which added said variable to said maximum, the value which subtracted said variable to said minimum value, and said average.

[Claim 2]

Said process (a) Said M is set to 1 (a-1), Process which gives the value of the pixel which touches above said interpolation pixel recently as said 1st candidate value (a-2), The field interpolation approach [equipped with the process which gives the value of the pixel which said interpolation pixel touches caudad recently as said 2nd candidate value] according to claim 1.

[Claim 3]

Said process (a) Said M is set to 3 (a-1), Are the upper part of said interpolation pixel, and on [which adjoin caudad] said two lines, and said interpolation pixel in the group of the pixel which is in the location of the symmetry mutually as a core
The field interpolation approach [equipped with the process which gives the value of the group which a value approaches most mutually as said 1st and 2nd candidate value] according to claim 1.

[Claim 4]

Said process (a) Said M is set to 3 (a-1), in the upper part of said interpolation pixel, and said each of two lines which adjoins caudad
Process which computes the value of the point of being located among said M pixels, based on the value of the M pixels concerned (a-2), Are on said two lines and said interpolation pixel in the group of the pixel which is in the location of the symmetry mutually as a core, and the group of a point
The field interpolation approach [equipped with the process which gives the value of the group which a value approaches most mutually as said 1st and 2nd candidate value] according to claim 1.

[Claim 5]

said process (e) ** (e-1) As opposed to each of the field of said N individual A process [reference value / multiplier / said / in said location corresponding to said interpolation pixel / motion],
(e-2) Said process (e-1) Based on a result, if all motion multipliers are lower than said reference value, said variable will be set as the absolute value of said pixel value range of fluctuation.
If all motion multipliers are higher than said reference value, said variable will be set as zero. When only some motion multipliers are lower than said reference value
The field interpolation approach [equipped with the process which sets up said variable highly, so that there are many motion multipliers lower than said reference value] according to claim 1 to 4.

[Claim 6]

said process (e) ** (e-3) With the process which computes and memorizes the motion multiplier in said interpolation pixel in said same field
The process which obtains said motion multiplier in said location corresponding to said interpolation pixel in the field of said N individual memorized, (e-4)
(e-5) Said process (e-4) The field interpolation approach according to claim 1 to 5 equipped with the process which computes said variable based on said obtained motion multiplier.

[Claim 7]

said process (e) ** (e-1) With the process which computes the motion multiplier in said interpolation pixel in said same field
(e-2) The process which memorizes the result for said motion multiplier as compared with a reference value,
(e-3) It is based on the comparison result of said motion multiplier and said reference value in said location corresponding to said interpolation pixel in the field of said N individual memorized.
If all motion multipliers are lower than said reference value, said variable will be set as the absolute value of said pixel value range of fluctuation.
If all motion multipliers are higher than said reference value, said variable will be set as zero. When only some motion multipliers are lower than said reference value
The field interpolation approach [equipped with the process which sets up said variable highly, so that there are many motion multipliers lower than said reference value] according to claim 1 to 4.

<HR>DETAILED DESCRIPTION
<HR>[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to the amelioration for controlling incorrect detection and the leakage in detection, without making the amount of operations increase especially about the field interpolation approach of changing an interlace image into a non-interlace image.

[0002]

[Description of the Prior Art]

By interpolating Rhine (scanning line) in each field of an interlace image, following 3 sorts of approach (1) - (3) is conventionally known as an approach of changing an interlace image into a non-interlace image.
Namely, (1) How to interpolate using the pixel of the adjoining field;

(2) Approach; interpolated using the upper part or the pixel which adjoins caudad, and (3) It is approach; interpolated using the upper part and the average of the value of a pixel which adjoins caudad.

[0003]

As an approach (1) is called interpolation between the fields and shown in
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TARGET="tjitemdrw">drawing 4</A>
(a), interpolation is performed using the pixel of the adjoining field.
An approach (2) and (3) are called the interpolation in the field, and as shown in
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(b), interpolation is performed in the same field.
In
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TARGET="tjitemdrw">drawing 4</A>
(a) and (b), an axis of ordinate V expresses the perpendicular direction on a screen (direction perpendicular to Rhine), and a sign (i-1), (i), and (i+1) express the identification number by which a number was assigned to the field in accordance with the passage of time amount.
The field (i) is the field made applicable to interpolation, the field (i-1) is equivalent to the field in front of one from it, and the field (i+1) is equivalent to the field after one.
Moreover, in
<A
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TARGET="tjitemdrw">drawing 4</A>
(a) and (b), a black dot expresses the pixel (interpolation pixel) made into the object of interpolation, and the white round head expresses the pixel contained in the interlace image before interpolation.

[0004]

The interpolation between the fields is suitable for a static image, and the interpolation in the field of another side is suitable for the dynamic image.
Namely, ** and unsuitable ****** corresponding to the motion of an image in each.
For this reason, in order to obtain a good non-interlace image, the amount of motions of an image is calculated and the approach of "motion ecad interpolation" which changes the interpolation in the field and interpolation between the fields gradually is taken.
By this approach, the motion multiplier k expressing the amount of motions of an image (0<=k<=1) is computed, and the value which carried out the weight average by the motion multiplier k is adopted as a value of a interpolation pixel to the value by the interpolation in the field, and the value by interpolation between the fields.
The motion multiplier k is k= 0 in a static image without a motion of an image, and is k= 1 in the large dynamic image of a motion.

[0005]

[Problem(s) to be Solved by the Invention]

However, if detection sensitivity is made high in order for the leakage in detection which detects an animation field as a still picture field to cause [one] image quality degradation in the conventional motion ecad interpolation and to avoid this On the contrary, in order for an animation field and the incorrect detection which detects to produce a still picture field and to raise detection precision, even if it made the amount of operations increase, there was a trouble that only the

effectiveness which ****s in it was not acquired.

[0006]

this invention was made in order to cancel the above-mentioned trouble in a Prior art, and it decreases incorrect detection and the leakage in detection through an easy operation -- making -- in addition -- and it aims at offering the field interpolation approach of realizing field interpolation which was adapted for a motion and profile of an image.

[0007]

[Means for Solving the Problem]

The approach of the 1st invention by interpolating Rhine in each field
The process which determines the value of the interpolation pixel which is a pixel on Rhine which is the field interpolation approach changed into a non-interlace image, and should interpolate an interlace image in the same field as the (a) aforementioned interpolation pixel -
The 1st candidate value which is the candidate of the value of said interpolation pixel based on the value of the pixel of M (>=1) individual nearest to said interpolation pixel on Rhine which adjoins above said interpolation pixel,
The 2nd candidate value which is the candidate of the value of said interpolation pixel based on the value of M pixels nearest to said interpolation pixel on Rhine which adjoins under said interpolation pixel,
The process to compute and the process which computes the maximum of the 1st candidate value of (b) above, and said 2nd candidate value,
(c) The process which computes the minimum value of said 1st candidate value and said 2nd candidate value,
(d) The process which computes the average of the pixel value in the location corresponding to said interpolation pixel in 2 fields which adjoin before and behind said same field,
(e) Depending on the motion multiplier in the location corresponding to said interpolation pixel in the field of N (>=1) individual chosen by within the limits before said same field, so that it may become so small that each of these motion multipliers is large
It has the process which computes the mean value of the process which computes the variable which changes in the range from zero to the absolute value of the pixel value range of fluctuation, the value which added said variable to the (f) aforementioned maximum, the value which subtracted said variable to said minimum value, and said average.

[0008]

In the field interpolation approach of the 1st invention by the approach of the 2nd invention
Said process (a) sets said M to 1, and is equipped with the process which gives the value of the pixel which touches above said interpolation pixel recently, and the process which gives the value of the pixel which said interpolation pixel touches caudad recently as said (a-2) 2nd candidate value as said (a-1) 1st candidate value.

[0009]

In the field interpolation approach of the 1st invention by the approach of the 3rd invention
Said process (a) sets said M to 3, is the upper part of said (a-1) interpolation pixel, and on [which adjoin caudad] said two lines, and said interpolation pixel in the group of the pixel which is in the location of the symmetry mutually as a core
It has the process which gives the value of the group which a value approaches most mutually as said 1st and 2nd candidate value.

[0010]

In the field interpolation approach of the 1st invention by the approach of the 4th invention
Said process (a) sets said M to 3, and sets to the upper part of said (a-1) interpolation pixel, and said each of two lines which adjoins caudad.

Are the process which computes the value of the point of being located among said M pixels, based on the value of the M pixels concerned, and on said (a-2) two lines, and said interpolation pixel in the group of the pixel which is in the location of the symmetry mutually as a core, and the group of a point
It has the process which gives the value of the group which a value approaches most mutually as said 1st and 2nd candidate value.

[0011]

In the field interpolation approach of the 1st thru/or the 4th one of invention by the approach of the 5th invention
Said process (e) receives each of the field of said (e-1) N individual.
A process [reference value / multiplier / said / in said location corresponding to said interpolation pixel / motion],
Based on the result of said process (e-1), if all motion multipliers are lower than said reference value, said variable will be set as the absolute value of said pixel value range of fluctuation. (e-2)
If all motion multipliers are higher than said reference value, said variable will be set as zero, and when only some motion multipliers are lower than said reference value, it has the process which sets up said variable highly, so that there are many motion multipliers lower than said reference value.

[0012]

In the field interpolation approach of the 1st thru/or the 5th one of invention by the approach of the 6th invention
The process said process (e) computes and remembers the motion multiplier in said interpolation pixel in said (e-3) same field to be,
(e-4) It has the process which obtains said motion multiplier in said location corresponding to said interpolation pixel in the field of said N individual memorized, and the process which computes said variable based on said motion multiplier obtained at said (e-5) process (e-4).

[0013]

In the field interpolation approach of the 1st thru/or the 4th one of invention by the approach of the 7th invention
The process at which said process (e) computes the motion multiplier in said interpolation pixel in said (e-1) same field,
The process which memorizes the result for said motion multiplier as compared with a reference value, (e-2)
It is based on the comparison result of said motion multiplier and said reference value in said location corresponding to said interpolation pixel in the field of said N individual memorized. (e-3)
If all motion multipliers are lower than said reference value, said variable will be set as the absolute value of said pixel value range of fluctuation.
If all motion multipliers are higher than said reference value, said variable will be set as zero, and when only some motion multipliers are lower than said reference value, it has the process which sets up said variable highly, so that there are many motion multipliers lower than said reference value.

[0014]

[Embodiment of the Invention]

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is a flow chart which shows the procedure of the field interpolation approach by the gestalt of operation of this invention.
Moreover,
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are the explanatory views showing the principle of the processing which met the procedure of
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.
In these drawings, the semantics of Sign V and a sign (i-1), (i), and (i+1) is the same as the semantics of the same sign of
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TARGET="tjitemdrw">drawing 4</A>
(a) and (b).
Sign H expresses the horizontal direction on a screen (direction parallel to Rhine).

[0015]

moreover -- a sign -- P -- interpolation -- a pixel -- expressing -- a sign -- A -- B -- C -- interpolation -- a pixel -- P -- belonging -- the field -- (-- i --) -- inside -- interpolation -- a pixel -- P -- the upper part -- adjoining -- Rhine -- a top -- interpolation -- a pixel -- P -- most -- being near -- three -- a piece -- a pixel -- expressing -- a sign -- A -- ' -- B -- ' -- C -- ' -- the field -- (-- i --) -- inside -- interpolation -- a pixel -- P -- a lower part -- adjoining -- Rhine -- a top -- interpolation -- a pixel -- P -- most -- being near -- three -- a piece -- a pixel -- expressing -- **** .
Pixel A and A' are in the location of the symmetry mutually considering the interpolation pixel P as a core.
Similarly, Pixel B, B', and Pixel C and C' are in the location of the symmetry mutually.
Pixel B and B' adjoin the interpolation pixel P perpendicularly.

[0016]

Furthermore, Sign X expresses the pixel of the location corresponding to the interpolation pixel P in the field (i-1) which adjoins in front of the field (i), and Sign Y expresses the pixel of the location corresponding to the interpolation pixel P in the field (i+1) which adjoins behind the field (i).
Moreover, in
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, the parallel band prolonged horizontally expresses Rhine (scanning line) which exists in each field from before interpolation.

[0017]

In a color picture, as a pixel value made into the object of an operation, preferably, although Y component (brightness component) is chosen, it is also possible to also use other components and to perform the operation same according to an individual about each of three components possible.
In addition, in order to give explanation a brief thing, a pixel and its value (pixel value) are expressed with the same sign below.

[0018]

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shows the procedure of processing to one interpolation pixel P, and processing of
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TARGET="tjitemdrw">drawing 1</A>
is repeated by every interpolation pixel P.
one -- a ** -- interpolation -- a pixel -- P -- receiving -- processing -- starting -- having -- if -- a pixel -- A -- B -- C -- a value -- being based -- interpolation -- a pixel -- P -- a value -- a candidate -- ****** -- a value -- D -- a pixel -- A -- ' -- B -- ' -- C -- ' -- a value -- being based -- interpolation -- a pixel -- P -- a value -- a candidate -- ****** -- a value -- D -- ' -- computing -- having (step S1) .

[0019]

the group which a value approaches most mutually in the interpolation pixel P in the group (A, A') of the pixel which is in the location of the symmetry as a core, (B, B'), and (C, C') in order to define the candidate value D and D' -- the group (D, D') of a candidate value -- then, it is good.
This means setting up the group (D, D') of a candidate value so that it may meet in the profile direction of an image.
For example, since the value of Pixel C and C' approaches most when the direction of a profile has extended from the upper right aslant to the lower left, it is determined as group [of a candidate value] (D, D') = (C, C').

[0020]

On two lines which the interpolation pixel P adjoins up and down, or the group of a pixel (A, A'),
the value of the point of being located between (B, B'), and (C, C') -- a weighted average -- using -- computing -- the group of 3 sets of pixels -- the group of those points -- in addition, it is good also considering the group which a value approaches most mutually in those groups as a group (D, D') of a candidate value.

[0021]

namely, as the group (A, A') of a pixel, and a group of a point which fills between (B, B')
it can supply, after calculating a group with a value 'rA- {1-r} -- B and rA -{1-r} B', and a group with a value 'rC- {1-r} -- B and rC -{1-r} C' can be filled up as the group (C, C') of a pixel, and a group of a point which fills between (B, B').
Here, r is the real number of the range of 0<=r<=1.
r= -- if it is 0 or 1, the group of these points is in agreement with either of the groups of 3 sets of pixels.
For example, if r= 0.5 is given as a value of r, the group (D, D') of a candidate value can be chosen from 5 sets including a pixel and a point.
The group (D, D') of the candidate value near the value of the thereby more original interpolation pixel P can be determined.

[0022]

r is treated as a variable and it is good also considering the group which a value approaches most mutually as a group (D, D') of a candidate value in the group of all the points corresponding to all r of the range of 0<=r<=1.
The group (D, D') of the candidate value near the value of the thereby further original interpolation pixel P can be determined.

[0023]

on the contrary -- as the simplest approach -- the inside of the group (A, A') of a pixel, (B, B'), and (C, C') -- the interpolation pixel P -- up and down -- only adjoining (A, A') -- it is also possible to take into consideration and to always

(D, D') determine the group of a candidate value as = (A, A').
In this case, it is not taken into consideration about the direction of the profile of an image.

[0024]

If the group (D, D') of a candidate value is defined, those maximum G=max (D, D') and minimum value L=min (D, D') will be computed.
Moreover, average Z= (X+Y) / 2 of the value of the pixels X and Y of the adjoining field are computed (step S2).

[0025]

furthermore, the step S -- in parallel to 1 and 2, the motion multiplier k in the interpolation pixel P (0<=k<=1) is computed (step S3).
Since the calculation of the motion multiplier k itself is common knowledge conventionally, detailed explanation is omitted.

[0026]

The variable s depending on the hysteresis of the motion multiplier k is computed by obtaining the motion multiplier k which moves and has already been computed next about the multiplier k and the location corresponding to the interpolation pixel P of the field before the field (i) which were newly computed at step S3 (step S4).
It is good for it to read the to move, to memorize multiplier k to a certain storage, and concerning the field of storage to the past motion multiplier k newly computed, for example.
The motion multiplier k itself is sufficient as what is memorized, and it may memorize only the motion multiplier k and size relation with a reference value T.
Variable s is computed so that it may become so small that each value of the motion multiplier k in the inside of hysteresis is large, and it may change in the range from zero to the absolute value of the pixel value range of fluctuation.
About the example of calculation, it mentions later.

[0027]

Termination of the both sides of step S2 and S4 computes G+s which added Variable s to Maximum G, L-s which subtracted Variable s to the minimum value L, and the mean value of the average Z (step S5).
Interpolation of Pixel P is performed by next determining the computed mean value as the value of the interpolation pixel P (step S6).
At step S6, a blending value with the interpolation value computed by the conventional approach may be adopted as a value of the interpolation pixel P instead of using a mean value directly.
A weighted average efficiency can be used as a blending value.
After processing of step S6 is completed, the interpolation to the interpolation pixel P is completed.

[0028]

Next, the operation (step S4) which defines Variable s is explained in full detail.
As an example, the motion multipliers k (i-2), k (i-1), and k (i) in the location corresponding to the interpolation pixel P in the three continuous fields (i-2), (i-1), and (i) shall be obtained in step S4.
These motion multipliers k are first compared with a reference value T.
A reference value T is the constant beforehand set up in 0< T<1, for example, is 1/4 near 0.

[0029]

If it is k(i-2) <T, k(i-1) <T, and k(i) <T as a result of a comparison, Variable s will be set as s= (absolute value of the pixel value range of fluctuation).
Thereby, since it becomes the maximum G> maximum pixel value and the minimum value L< minimum pixel value, the mean value computed at step S5 is set to median()=Z.
Adopting this mean value as the value of the interpolation pixel P means using to the interpolation pixel P and performing interpolation between the fields.
That is, in the hysteresis of the fixed range, when an image is close to a static

image thru/or it, interpolation between the fields is chosen.

[0030]

If it is k(i-2) >=T, k(i-1) >=T, and k(i) >=T as a result of a comparison, Variable s will be set as s= 0.
Thereby, the mean value computed at step S5 serves as median()=median (G, L, Z).
If this mean value is adopted as the value of the interpolation pixel P, since interpolation will be performed with the value below G and more than L, generating of the noise by the leakage in detection can be suppressed.

[0031]

the result of a comparison -- case only the part in k (i-2), k (i-1), and k (i) is lower than a reference value T -- Variable s -- 0<s -- < (absolute value of the pixel value range of fluctuation) -- it is the range, and it is set up so that it may become so high that there are many motion multipliers lower than a reference value T.

[0032]

In addition, although the above explanation showed the example as which the hysteresis covering the 3 field is considered as hysteresis of the motion multiplier k, the hysteresis covering the field more than it or not more than it may be taken into consideration.
For example, it is also possible to take into consideration motion multiplier [of the field (i) where the interpolation pixel P belongs] k (i).
In this case, if it is k(i) <T, it will be set as s= (absolute value of the pixel value range of fluctuation), and if it is k(i) >=T, it will be set as s= 0.

[0033]

Moreover, it is also possible only for the motion multiplier of the field before the field (i) to define Variable s only in consideration of the hysteresis of the motion multipliers k (i-2) and k (i-1).
That is, it is possible to define Variable s generally based on the hysteresis of the motion multiplier of the field of N (>=1) individual chosen by within the limits before the field (i).
Although continuing is desirable as for the field of N individual when it is N>=2, it is also possible to take a not continuous gestalt.

[0034]

Furthermore, in
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, although step S3 and S4 illustrated the procedure in which the effectiveness performed in parallel to steps S1 and S2 was high, performing mutually almost simultaneously is also possible.

[0035]

[Effect of the Invention]

The value which the variable which changes from zero in the range to the absolute value of the pixel value range of fluctuation was computed by the approach of the 1st invention based on the hysteresis of a motion multiplier, and added the variable to maximum,
Since the mean value of the value which subtracted the variable to the minimum value, and the average is computed, field interpolation which was adapted for the motion of an image is realized through the single operation of moreover computing a mean value, decreasing incorrect detection and the leakage in detection.

[0036]

By the approach of the 2nd invention, as the 1st and 2nd candidate value, since the upper part of a interpolation pixel and the value of a pixel which touches caudad

recently are given, an operation is simplified further.

[0037]

By the approach of the 3rd invention, as the 1st and 2nd candidate value, since it is chosen from the value of 3 sets of maximum contiguity pixels, the suitable candidate value according to the direction of the border line of an image is chosen.

[0038]

By the approach of the 4th invention, since not only the value of 3 sets of maximum contiguity pixels but the value filled up based on them is applied and the 1st and 2nd candidate value is chosen from these whole, a more suitable candidate value is acquired.

[0039]

By the approach of the 5th invention, since a motion multiplier is compared with a reference value and a variable is defined based on the result, the operation which calculation of a variable takes is simplified.

[0040]

By the approach of the 6th invention, since the value which was memorized after the motion multiplier in the interpolation pixel in the same field was computed, was already computed and was memorized as a motion multiplier of N individual required for calculation of a variable is used, the effectiveness of an operation improves.

[0041]

By the approach of the 7th invention, since a motion multiplier is compared with a reference value and a variable is defined based on the result, the operation which calculation of a variable takes is simplified.
And since the result which the result was memorized and was already memorized as a comparison result of N individual required for calculation of a variable is used after the motion multiplier in the interpolation pixel in the same field is computed and being compared with a reference value, when a storage etc. is used, the storage capacity can be reduced.
Moreover, the effectiveness of an operation also improves further.

<HR>DESCRIPTION OF DRAWINGS
<HR>[Brief Description of the Drawings]

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It is the flow chart which shows the procedure of the approach of the gestalt of operation.

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It is the explanatory view showing the principle of processing in alignment with
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TARGET="tjitemdrw">[Drawing 4]</A>

It is the explanatory view showing the principle of the conventional approach.
<BR>[Description of Notations]

<BR>A, B, C    The maximum contiguity pixel
<BR>A', B', C'    The maximum contiguity pixel
<BR>D   The 1st candidate value
<BR>D'    The 2nd candidate value
<BR>G   Maximum
<BR>k   Motion multiplier
<BR>L   Minimum value
<BR>P   Interpolation pixel
<BR>s   Variable
<BR>T   Reference value
<BR>X, Y    Pixel
<BR>Z   Average
<BR><BR>
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